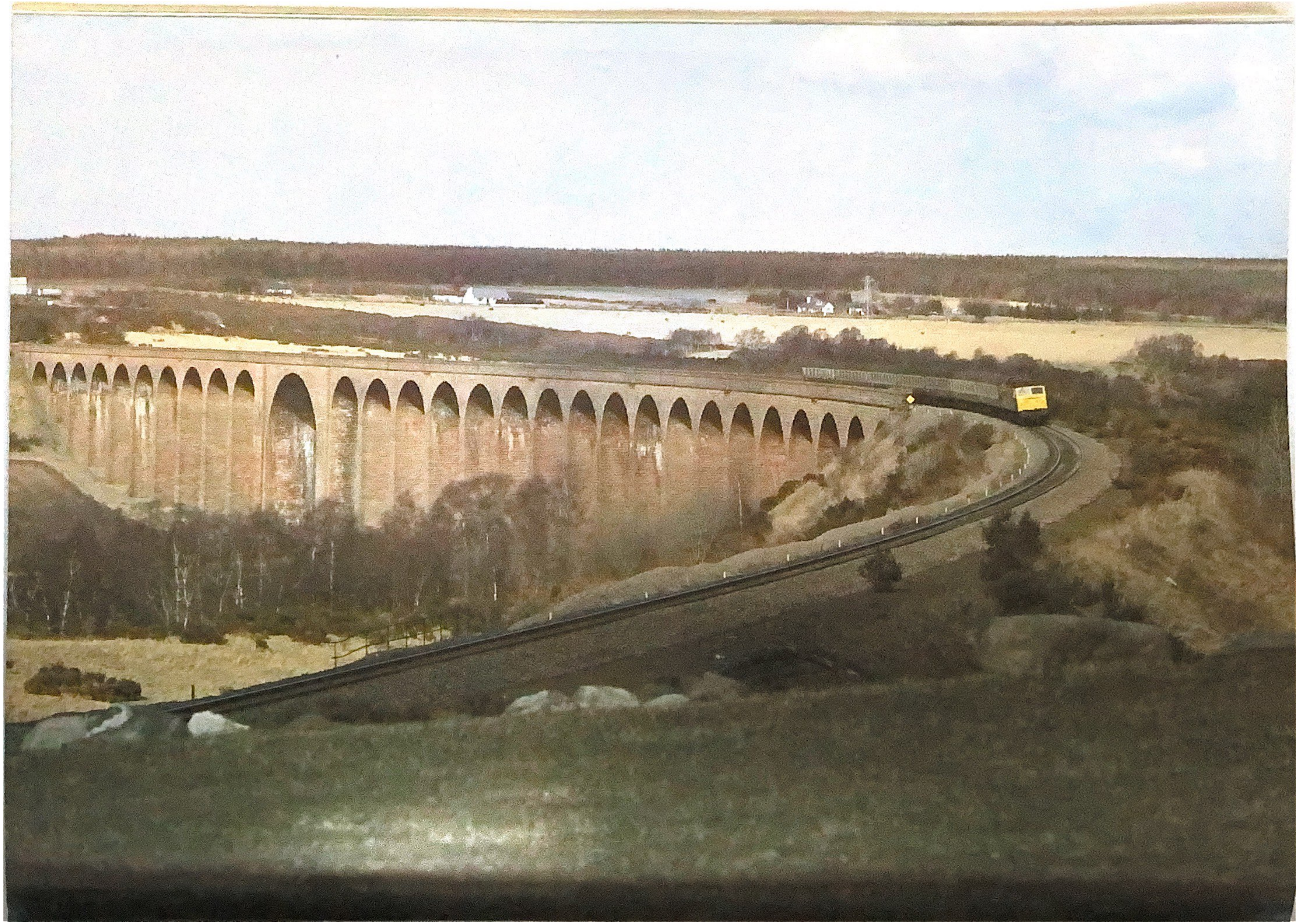


MODERN TRACTION PERFORMANCE

ScotRail services

Martin Beckett and David N. Clough

THE geographical features which distinguish Scotland from the more southerly parts of the country also give its railways a distinct character and help to shape their operations. ScotRail's 1,700 route miles include many lengthy sections of single track in scenic but sparsely populated districts; in other areas there are lines with quite substantial internal traffic.

Until recently, the Region's internal services have had only a low priority for BR's resource allocation. There is still much use of Mk 1 stock, and the Region is the last to make regular use of steam heating. There was much use of Type 2 diesels in pairs until the early 1980s and, except for the Glasgow suburban area and the main line south to Carlisle, electrification is as yet still in the future although with the Ayrshire and ECML schemes now making progress the pace is increasing. More than any other part of the BR system, the Region has managed to retain an independence which in recent years has seen the introduction of the ScotRail title, the use of a new house livery and a distinct effort to make the most of Scotland's natural scenic assets to attract passenger business. Combined with some new equipment and the refurbishment of older stock, and modernisation of stations while retaining their character, these factors have produced improved results.

However, there is a tendency for the Region still to be regarded as merely the destination of Anglo-Scottish main line services. This article attempts to examine some of the services which show that this is not the case. An earlier article in this series described the West Coast main line electrification to Glasgow, so it is appropriate to begin by considering running on the Region's busy main line to Edinburgh.

Serving the two largest cities in Scotland, this fast and direct route has good commercial prospects, thanks to the large catchment areas and well-sited stations at either end. The service formerly provided by Swindon-built Inter-City diesel units, and then by Mk 2 coaches worked in push-pull fashion by pairs of Class 27s, now relies on the power of Class 47/7s, a small sub-class of 16 specially adapted locomotives whose best known feature is that they can be driven remotely from a Mk 2F driving brake trailer, the control signals being transmitted via the train lighting cables. By keeping loadings down to around 200 tons (six coaches) it was possible to aim for speeds of 100mph on these services and this was felt to be a worthwhile commercial objective.

Although the 47/7s are passed to run at 100mph, the traction motors fitted to Class 47s are prone to failure at high speed. Between 1982 and 1985, 47/7s received modifications to their field weakening systems in an attempt to reduce component failures. The effect of this is to lower the speed at which full generator unloading takes place, and while they may be more reliable at full service speed than a normal 47/4 the modified 47/7s now require more time to reach that speed. Thus the main characteristics of the running on this route are rapid acceleration and fast cruising, rather than maximum speed. Examples of runs are shown in Tables 1 and 2. Running at up to 100mph makes the timing of eastbound journeys particularly difficult from the low seat position of Mk 3 stock. The mileposts are in a variety of styles, including some of the curious Edinburgh & Glasgow Railway pattern at the western end of the route which can prove especially hard to spot.

Left:
An impressive view of the scale of Culloden Viaduct, with Class 47/0 No 47152 heading the 14.30 Inverness-Edinburgh Waverley on 17 April this year. *Les Nixon*

Below:
The new order north of Inverness in 1986: Class 37/4 Co-Cos Nos 37421/16 approach Inverness with the morning train from Wick and Thurso, 19 April. *Les Nixon*

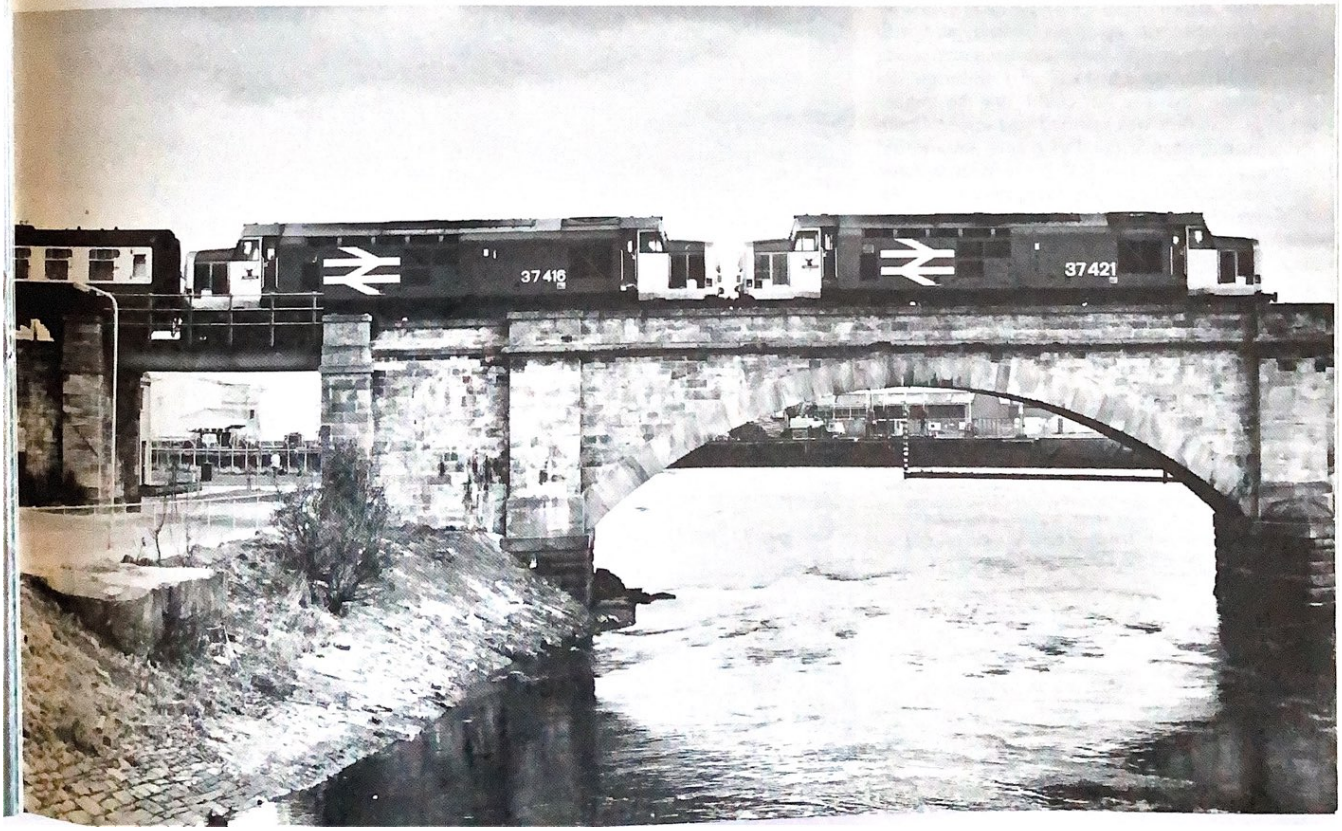


Table 1: Glasgow to Edinburgh

Train: 12.00 Glasgow-Edinburgh

Locomotive and stock: No 47706 *Strathclyde*: 6 coaches 200 tons tare/ 210 tons full

Miles			*min - sec*	*mph*
0.00	Glasgow Queen Street	dep	0 - 00	–
1.85	Cowlairs Box		3 - 46	40
3.24	Bishopbriggs		5 - 10	68
5.38	Cadder Box		7 - 43	50
6.25	Lenzie		8 - 37	58
11.50	Croy		12 - 42	86
17.33	Greenhill Upper Junction Box		17 - 30	58
21.79	Falkirk High		20 - 54	86
25.00	Polmont		23 - 05	90
29.70	Linlithgow		26 - 05	95
34.68	Winchburgh Junction		29 - 21	82
39.09	Ratho		32 - 34	83
			tsr	20* (MP42-42¾)
46.06	Haymarket	arr	41 - 53	–
1.24	Edinburgh	arr	3 - 12	–

* Speed restriction

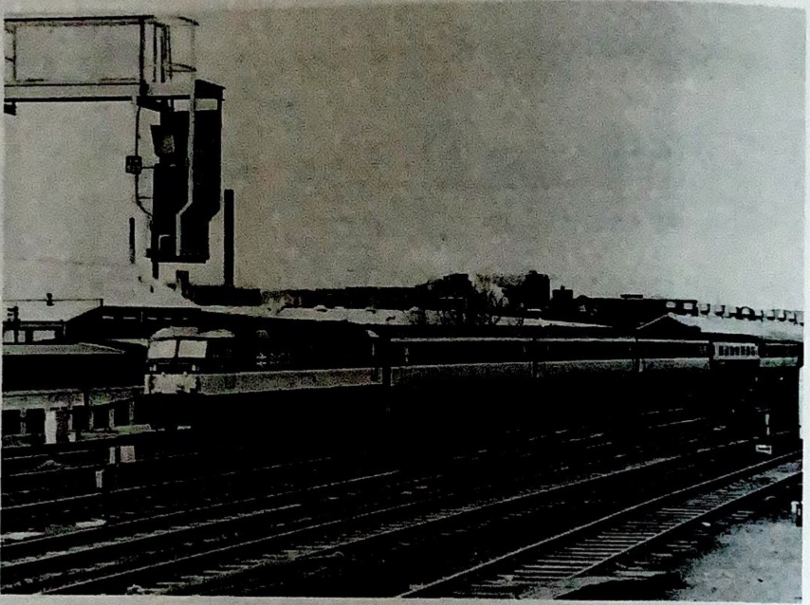
Table 2: Edinburgh to Glasgow

Train: 11.30 Edinburgh-Glasgow

Locomotive and stock: No 47716: 6 coaches 200 tons tare/210 tons full

Miles			*min - sec*	*mph*
0.00	Edinburgh	dep	0 - 00	–
1.24	Haymarket	arr	3 - 22	–
6.97	Ratho		6 - 39	88
11.38	Winchburgh Junction		9 - 48	80
16.36	Linlithgow		13 - 14	90
21.06	Polmont		18 - 57	70
24.27	Falkirk High	arr	22 - 34	–
4.46	Greenhill Upper Junction		4 - 42	86
10.29	Croy		8 - 31	96
15.54	Lenzie		11 - 47	97
16.41	Cadder Box		12 - 19	96
18.55	Bishopbriggs		13 - 43	90 braking
19.94	Cowlairs Box		14 - 48	60
21.79	Glasgow Queen Street	arr	18 - 34	–

On the 1985 run shown in Table 1, No 47706 *Strathclyde* was in charge of a service booked non-stop to Haymarket; trains now also call at Falkirk High and a few stop additionally at Linlithgow. The difficult start out of Queen Street no longer presents the problems it once did, and by Cowlairs acceleration was well under way. Beyond Bishopbriggs, a signal check brought speed down to about 30mph, so that the acceleration had to begin again. Thus at Croy the train was still outside even time, and to make things worse another check was experienced approaching Greenhill Junction where trains bound to or from Stirling and Perth join or leave the Edinburgh line. Once again, the drop in speed was substantial, from around 90 to below 60mph. So, for the third time, No 47706 was called upon to regain normal running speed for the service, and by Falkirk had made good progress. It was not until after Polmont, though, that the speed was sustained at above 90mph, and with the long speed restriction for engineering work on the outskirts of Edinburgh the usual fast run in could not be made. Haymarket was reached just inside 42min from Queen Street, but at least 3min would have been saved had it not been for the various checks. For comparison, a 1986 westbound run booked to call at Falkirk is shown in Table 2. The locomotive, No 47716, was one of four additional locomotives fitted for push-pull working to allow this principle of operation to be extended to the Glasgow-Perth-Aberdeen service. At the time of the run 47716 was un-named, though it is understood that in due course these later conversions will receive appropriate names. On the level track acceleration on leaving Haymarket was enough to produce 55mph in little more than a mile, and 70mph was reached by the time the lines to Glasgow and Dundee diverge just beyond the site of the former Saughton Junction. Speed was worked up into the mid-90s before Linlithgow, but soon afterwards a severe signal check brought the train down almost



Above right:

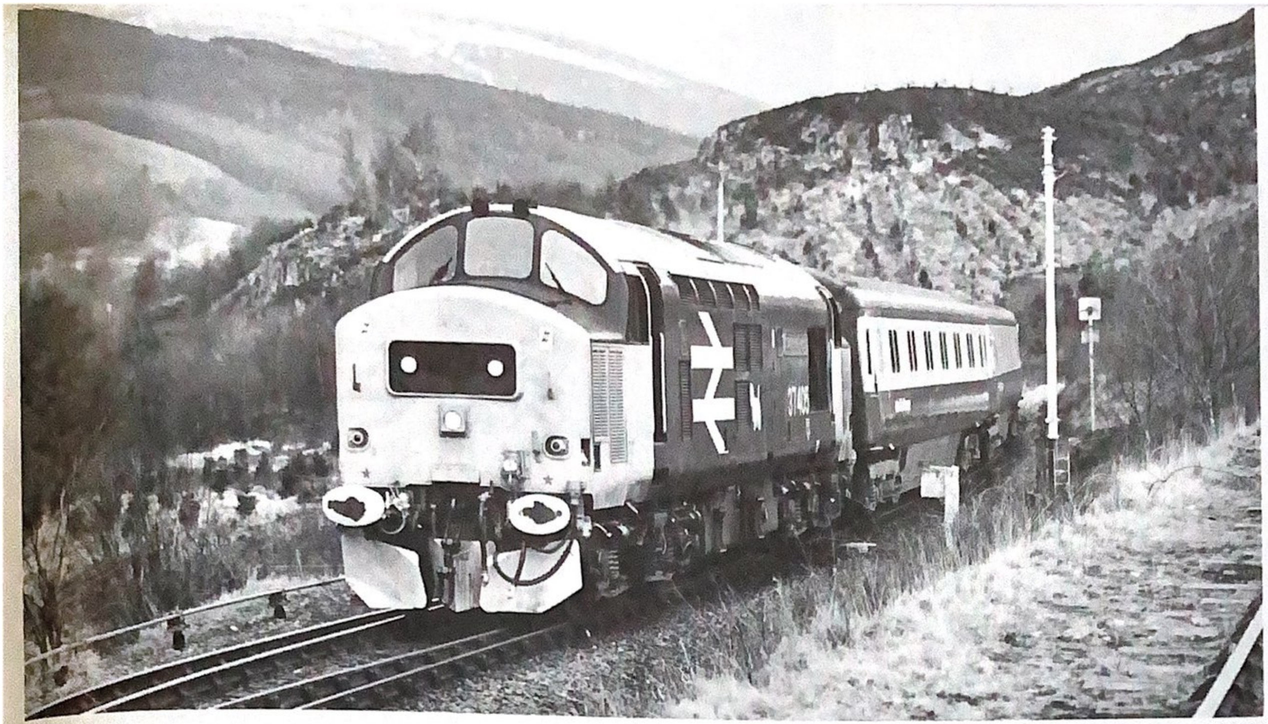
Westwards past Haymarket depot goes Class 47/7 Co-Co No 47714 (since named) propelling a five-car push-pull set forming the 09.30 Edinburgh Waverley-Glasgow Queen Street on 27 April 1985. ScotRail Express liveried locomotive and four coaches — the interloper is a Mk 2D open first.

W. A. Sharman

Right:

On 24 March this year, Class 47/4 Co-Co No 47461 *Charles Rennie Mackintosh* approaches Welsh's Bridge signalbox as it leaves Inverness with the 10.30 to Euston.

John S. Whiteley



Above:
Class 37/4s have taken over on the West Highland line, such as No 37405 *Strathclyde Region* at Tulloch with the 17.40 Fort William-Glasgow Queen Street conveying Mk 3 sleeping cars for Euston behind the locomotive. *Les Nixon*

to a stop near Manuel. In the distance remaining before the Falkirk stop, there was no opportunity to regain full speed. Farther west, No 47716 easily reached and held speeds in excess of 95mph, with the 12 miles from MP16 to MP4 being run at this average. The present method of operation seems well-suited to the demands of the service, and although the 47/7s spend much of their time accelerating or running at high speed they have other duties of a less exacting nature. For example, one Sunday turn includes a run to Inverness via Perth and Aberdeen. Another of the class is usually employed between Edinburgh and Carstairs, and this has the advantage of being quite close at hand if required to substitute for another locomotive on the Edinburgh-Glasgow service.

The development of Class 37/4 is another example of how an existing design can be adapted to the special requirements of service in Scotland. Although Class 37s have worked passenger trains in Scotland for several years, increasing age and the arduous nature of the duties were beginning to affect their reliability. Maintenance and operation of boiler-fitted locomotives is expensive, and the fleet of steam-heat stock is dwindling and ageing, too. Adoption of ETH working was the only answer, and the introduction of Mk 3 sleepers on the Fort William service made this essential. As a stop-gap measure, the 'ETHEL' system was devised and three former Class 25s were converted at Eastfield to provide ETH on trains hauled by Class 37s. The entry into service of the refurbished and ETH-fitted 37/4s has taken longer than had been hoped, but both Eastfield and Inverness depots have now received their full allocation of 25 locomotives. A February 1986 visit to the Inverness area provided the opportunity to sample their performance on the Far North line, the stronghold for so long of the veteran Class 26s — now allocated to the Railfreight sector.

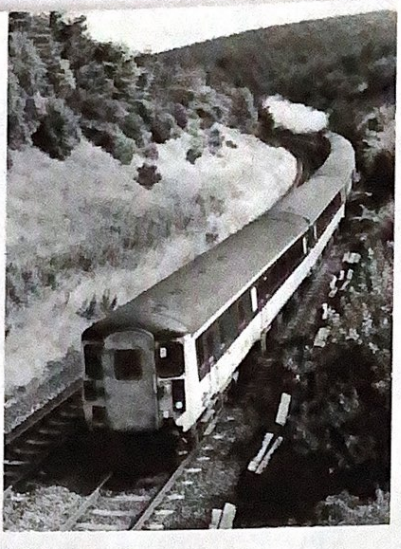
The route provides opportunities for rapid acceleration and fast running, depending on the distance between stations, and for the development of maximum power output on uphill sections. The early morning departure from Inverness is usually the heaviest of the three daily weekday services, as it conveys mails and is given a D315 timing load. This corresponds to nine coaches, but on the run shown in Table 3 No 37419 had only a seven-coach train of around 250 tons. At so early an hour on a cold February morning it was too dark to record full timings until Invergordon, but the average speeds show that the performance, especially on starting and accelerating, benefited from the lower gearing and new electronic control systems incorporated with refurbishment. Given the chance, No 37419 showed itself able to reach 70mph with this load, and the acceleration to 38mph on the 1 in 72 climb from Invershin showed that plenty of power was available at lower speeds, too. After restarting from Lairg, 37419 reached 36mph before the summit was passed.

Table 3: Inverness-Rogart

Train: 06.35 Inverness-Wick/Thurso — the 'Orcadian'
Locomotive and stock: No 37419: 7 coaches 235 tons tare/250 tons full

Miles			*Sched*	*min - sec*	*mph*
0.00	Inverness	dep	–	0 - 00	–
1.63	Clachnaharry		5	4 - 33	10*
5.86	Lentran		13	10 - 58	–
13.05	Muir of Ord	arr	21	19 - 22	–
3.20	Conon			4 - 40	–
5.68	Dingwall	arr	7	8 - 14	–
4.22	Foulis			5 - 40	66/68
6.27	Evanton			7 - 38	65
10.15	Alness	arr	12	11 - 44	–
2.48	Invergordon	arr	4	4 - 34	–
3.63	Delny Crossing			4 - 56	60
5.27	Kildary			6 - 43	63
7.95	Nigg Crossing			9 - 08	
				tsr	20*
9.24	Fearn	arr	13	11 - 35	–
3.63	Tain	arr	5	5 - 25	53 max/–
5.37	Edderton			6 - 29	68/69
13.59	Ardgay	arr	15	15 - 08	–
3.12	Culrain		7	4 - 43	25
3.55	Invershin		9	5 - 32	33/38 max to MP64
9.10	Lairg	arr	19	13 - 46	58 max/–
2.44	Lairg Summit			4 - 59	36
10.08	Rogart	arr	13	12 - 52	67 max/–

* Speed restriction



Above:
A ScotRail Express working — the 13.05 Aberdeen-Glasgow Queen Street seen between Stonehaven and Drumlithie on 17 August 1985, with power being visibly expended by Class 47/7 Co-Co No 47709 *The Lord Provost* at the rear. *D. M. May*

Southbound, the long ascent from Rogart to Lairg Summit provides another excellent test of full power output. The gradients vary between 1 in 70 and 1 in 300 (the latter over a very short distance only), but taking the average as 1 in 85 it was found that two different 37/4s averaged 47mph with six-coach trains of some 210 tons full. This indicates an edhp value of 1,250; the corresponding rail horsepower figure of 1,340 means that after taking power supplied for train heating into account the full rated output was being developed. The refurbishment seems to have made basically good locomotives even better, and their greater reliability and versatility should enable the costs of the work to be recovered. From the passenger's viewpoint the assurance of a warm train is a distinct gain over the increasingly erratic and unreliable steam heating formerly used.

Since the 1984/85 timetable, passenger services over the Highland main line have included a through IC125 working to and from King's Cross. Given the proud title the 'Highland Chieftain' this service is currently booked to cover the 582 miles in just under 8½hr, an average speed of more than 72mph. This is an impressive example of the new service possibilities opened up by IC125s. Probably only few of the 'Chieftain's' passengers make the complete journey, but even for those travelling only within Scotland or just over the Border the improved journey times and connectional opportunities are worthwhile advantages. There was no comparable predecessor of this service; even the immediate forerunner, the 'Clansman', dates only from May 1974 and only became possible when sufficient numbers of Type 4 diesels could be released from the demands for their services elsewhere.

When first introduced, the 'Chieftain' was booked to leave Inverness at the early time of 07.20, though on the first run shown in Table 4 departure was delayed by 22min awaiting a late-running connection from the Aberdeen direction. This, too, was a mid-February morning, and as it was still not fully light on departure the surprise feature of the run did not become apparent until some time later: namely that the IC125 had been provided with a Class 47 as pilot! The reason for this was not obvious, as both power cars were certainly working. But on joining the train there were indications that the heating and lighting systems were not entirely effective in some cars and it may have been that these problems made the pilot desirable. Whatever the reason, the presence of what was effectively a third power car meant that around 7,000bhp was available with which to tackle the formidable climbs. It was certainly put to good use, for on the initial 1 in 60/70 section a maximum of 73mph was attained. The late start meant that an incoming northbound service needed to be crossed on the double track before Culloden, rather than at one of the loops further south. To allow this without having to come to a dead stand, it was necessary to come down to no more than 20mph before the crossing was made just north of Culloden. The speed at the foot of the next section of 1 in 60 was therefore lower than normal, but with so much power available recovery was rapid: by Daviot the train was doing more than 70mph. The 'summit' at Milepost 105 was topped at a remarkable 74mph. Speeds of this order could never have been contemplated by the Highland Railway when the direct line south from Inverness was built to avoid the long detour via Forres and Dava. The final steep ascent from Tomatin to Slochd saw speed rising again to almost 70mph at the summit.

Table 4: Inverness-Aviemore

Miles			Run 1 Sched	Run 1 min - sec	Run 1 mph	Run 2 min - sec	Run 2 mph		Run 3 Sched	Run 3 min - sec	Run 3 mph
0.00	Inverness	dep	–	0 - 00	–	0 - 00	–	dep	–	0 - 00	–
0.65	Millburn Junction		3	2 - 25	25	1 - 52	30		3	1 - 54	30
6.50	Culloden Moor		8½	9 - 19	20	8 - 32	40*		12	9 - 35	42*
10.74	Daviot		–	13 - 35	71	13 - 04	58		–	15 - 15	45
14.74	Moy		16	–	–	16 - 54	70/64		23	19 - 54	67/58
18.91	Tomatin		20	20 - 32	66	20 - 36	59		27	26 - 10	sigs
22.53	Slochd Summit		23½	23 - 49	68	24 - 07	60		32	31 - 12	50
27.86	Carrbridge		28½	28 - 27	62	31 - 20	sig stop	arr	38	37 - 39	–
34.60	Aviemore	arr	34½	34 - 35	–	44 - 39	–	arr	7	7 - 25	–

* Speed restriction

Run 1: 07.20 Inverness-King's Cross — the 'Highland Chieftain' No 47546 + IC125 2+8 (power cars 43152 and 43067)

Run 2: 07.50 Inverness-King's Cross — the 'Highland Chieftain' IC125 2+8

Run 3: 16.30 Inverness-Edinburgh No 47550, 8 coaches, 257 tons tare/270 tons full

Estimated power output from MP110½ to MP105½ on 1 in 60: 2,010edhp (2,100rhp)

By comparison with this remarkable effort, the speeds achieved by the unaided 1986 log shown as run 2 seem quite modest, yet the actual running was of a high quality. Getting away from Inverness punctually at the revised time of 07.50, full timings were possible on a cold, crisp winter morning with deep lying snow on the higher ground. The maximum before Culloden was 62mph, though there may have been slight slipping in the very cold conditions. The speed on passing Culloden needed to be reduced only to the restriction imposed over the impressive viaduct and so the 1 in 60 beyond was commenced at a higher speed than on the piloted run. Even so, it was not possible to reach 60mph before Daviot although this was just achieved at Milepost 105: again, it is possible that wind-blown snow had caused some loss of adhesion or made it inadvisable to use full power. Yet speed was held at 60mph from Tomatin up to Slochd Summit, but the late running of a northbound overnight service caused a 5min wait at Carr Bridge and therefore time was dropped to Aviemore.

Run 3 is included to show the running of a typical locomotive hauled train on this difficult section. With a class as numerous as the 47s, the scope for individual variations in output is considerable, and in fact such differences are often encountered to confuse the recorder. Analysis of the uphill work of No 47550 shows that on this run the power unit was delivering its full rated output of 2,580bhp, so that the times and speeds achieved represent the best possible with this load.

To round off this survey Table 5 contains an example of the work of what is now an endangered species, the Class 27, on the Edinburgh-Dundee line. Nowhere else on BR were Type 2 steam heating diesels still to be found regularly on passenger duties at the time of writing, and even on this route their future is by no means assured. Although loads are light, the frequent stops, speed restrictions and gradients require quite vigorous running to keep time and with members of the class well into their twilight years performances can differ considerably between locomotives. While perhaps not as good as the best efforts, No 27017 was well up to the job and gave a good account of itself. Once clear of Edinburgh 75mph was attained before Dalmeny but a brief signal stop outside Inverkeithing led to slight loss of time. The climb to Dalgetty was topped at around 50mph, but acceleration afterwards was slow. The speed restrictions at Burntisland and Kinghorn prevented fast running except for a short distance before Kirkcaldy. Another uphill start produced

Table 5: Edinburgh-Dundee

Train: 13.15 Edinburgh-Dundee
Locomotive and stock: No 27017: 4 coaches 130 tons tare/135 tons full

Miles		*Sched*	*min - sec*	*mph*
0.00	Edinburgh	dep –	0 - 00	–
1.24	Haymarket	arr 3	3 - 01	–
3.30	South Gyle		4 - 11	72
8.20	Dalmeny		8 - 15	40
10.04	North Queensferry		10 - 46	44
11.91	Inverkeithing	arr 14	14 - 48	sigs/–
4.28	Aberdour		5 - 50	51
6.98	Burntisland		9 - 11	32*
9.59	Kinghorn		12 - 54	30*/40
10.58	Seafield Box		14 - 16	50
12.78	Kirkcaldy	arr 19	16 - 33	66 max/–
2.07	Dysart		3 - 27	50
4.75	Thornton Junction		6 - 34	55/60
7.32	Markinch	arr 9	9 - 19	–
2.90	Falkland Road		4 - 35	70
5.85	Ladybank	arr 9	7 - 11	82 max/–
3.23	Springfield		4 - 14	75
5.53	Cupar	arr 7	6 - 33	–
2.95	Dairsie		5 - 25	55
6.22	Leuchars	arr 8	8 - 56	69 max/–
3.65	St Fort		4 - 49	67
5.60	Tay Bridge South		6 - 43	40*
7.60	Esplanade		10 - 19	sigs
8.34	Dundee	arr 15	15 - 51	–

* Speed restriction

50mph on the 1 in 100 past Dysart, and speed just reached 60 in the dip at Thornton Junction, thus allowing time to be kept to Markinch. Restarting, No 27017 was able to reach 43mph on the 1 in 102 climb and then accelerated well to pass Falkland Road at 70; the maximum on the following descent was 82 before braking for Ladybank. The concluding stages to Dundee did not call for any notable effort and the slight loss of time was due entirely to engineering work after Cupar and a signal check approaching Dundee. The same locomotive ran equally well on the return working to Edinburgh, though the run is not reported here. Despite their age, these locomotives can still give useful service, though the costs of operating must be higher than would be possible with more modern equipment.

Above:
The 07.50 Inverness-King's Cross 'Highland Chieftain' approaches Stirling on 8 July 1985 with IC125 power car No 43101 *Edinburgh International Festival* leading. *D. M. May*

Below:
Dying breed — Class 27/0 No 27004 with steam-heated Mk 2 stock leaves Dundee with the 15.30 to Edinburgh Waverley on 14 March this year. *A. O. Wynn*